

salt selected from the group consisting of aluminum nitrate and aluminum oxide.

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Claim 11 A process as claimed in claim 8, wherein the source of zinc is a salt of zinc selected from the group consisting of zinc nitrate, zinc sulfate, zinc chloride and zinc oxide.

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Claim 12 A process as claimed in claim 8, wherein the source of chromium is an ammonium salt selected from the group consisting of ammonium dichromate and ammonium chromate.

REMARKS

The above amendatory action is taken more completely to define the subject matter which Applicants regard as their invention. The newly added claims correspond to and draw support from, the originally filed claims and are patentable over the cited art in the parent application for the reasons discussed in the Amendment dated July 19, 2000. These reasons are reproduced below.

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The Examples of the specification show the criticality of including in the claimed catalyst the four metals recited in the claims, and only those four metals, in the recited proportions. The Examples are summarized as follows:

Example	Catalyst Components	Selectivity For THF
1	Cu, Al, Zn, Cr	90%
2	Cu, Al, Cr	< 30%
3	Cu, Zn, Cr	< 25%
4	Cu, Cr	< 20%
5	Cu, Cr, Bn, Zn, Al	< 25%
6	Cu, Cr, Ba, Zn, Al	< 54%

Furthermore, as noted on page 10 of the specification, the catalysts of the claimed invention show prolonged activity (at least 630 hours).

The claims stand rejected under 35 USC 103(a) as allegedly being unpatentable over Kawai et al in view of Rashkin. In maintaining this rejection, the Examiner has stated that the use and selectivity of the claimed catalyst is moot because the Applicant is not claiming a use for the catalyst. Applicants respectfully submit that this is an incorrect statement of the law. Under well settled case law, all evidence of the properties of a claimed composition and the prior art must be considered in determining the ultimate question of patentability (see *In re Dillon*, 16 USPQ 2d 1897, 1901 (Fed. Cir. 1990)). Indeed, it is well established that evidence of unobviousness or unexpected or advantageous properties of a claimed composition is sufficient to rebut a *prima facie* case of obviousness (see e.g., MPEP Section 716.02(a)). As discussed below, the evidence in the specification of the unexpected properties of the claimed catalyst would be sufficient to overcome an alleged *prima facie* case of obviousness based upon the cited references. First, however, Applicants will discuss why the cited references are not sufficient even to set forth a *prima facie* case of obviousness.

The claimed invention recites a very specific copper chromite catalyst having a definite molar composition comprising Cu, Cr, Al, Zn and a specific XRD pattern. As claimed, the catalyst must comprise all four of these elements (and only these four elements) in the recited proportions. By contrast, although the Kawai et al reference teaches a genus comprising copper catalysts containing a large number of possible combinations of components, there is nothing in the reference that would motivate one of ordinary skill in the art to select from among all

possibilities the claimed four (and only four) components in the recited quantities. Under these circumstances, the claimed catalyst cannot be considered to be obvious from the reference (see MPEP Section 2144.08).

As discussed in MPEP Section 2144.08, the fact that a claimed species or subgenus is encompassed by a prior art genus is not sufficient by itself to establish a *prima facie* of obviousness. In the present case, the Examiner considers Kawai to teach a catalyst consisting of copper and zinc and/or chromium and at least one of molybdenum, tungsten, magnesium, barium, aluminum, calcium, zirconium, cobalt, manganese and nickel. However, the reference teaches only that the described copper catalysts may contain "at least one metal selected from the group consisting of zinc and chromium". Although this obviously encompasses both zinc and chromium, there is no motivation provided in the reference to include them both. Moreover, there is no motivation for selecting aluminum from among the group of compounds described in column 4 at lines 44 - 47. There is further no motivation to select four and only four components for inclusion in the claimed catalyst (note that Kawai also encompasses in the list of possibilities "a mixture of at least two of these metals", see column 4, lines 46 - 47). There is also no motivation in Kawai for selecting the claimed percentages of the recited elements from among the broad ranges described in Kawai. In the absence of any motivation to select the claimed variables from the numerous possibilities described in the reference, the reference cannot be used to set forth even a *prima facie* case of obviousness (see *In re Baird*, 29 USPQ 2d 1550 (Fed. Cir. 1994)).

The secondary reference cited by the Examiner, Rashkin, cannot supplement the

deficiencies in the primary reference. Rashkin teaches a copper chromium-zinc-barium catalyst, which is not the same as the copper-chromium-zinc aluminum catalyst of the present invention. Rashkin catalyst consists of (a) 30 - 55% by weight CuO, 30 - 57 weight percent Cr₂O₃, and up to 16 weight percent BaO and (b) 1 - 13 weight percent ZnO. The catalyst is a barium copper chromite catalyst, which has been impregnated with zinc. There is absolutely no motivation in the cited art to combine the disclosure of Rashkin with the disclosure of Kawai. Nor is there any suggestion in the prior art to substitute aluminum for the barium in the Rashkin catalyst, and indeed, Rashkin teaches away from such substitution. Under these circumstances, the cited references may not properly be combined to arrive at the claimed invention (see, e.g., *In re Grabiak*, 226 USPQ 870 (Fed. Cir. 1985)).

Even assuming for the sake of argument that the cited references were properly combinable, the combination would not arrive at the claimed invention. There are at least four major differences in properties between the Rashkin catalyst (even when read with the Kawai et al reference) and the catalyst of the claimed invention.

1. The catalyst of the present invention, even after calcination, reduction and pelletization, requires *in situ* activation under a steady stream of hydrogen or a mixture of hydrogen and an inert like nitrogen before use for hydrogenation (see the specification at page 4, last line and page 5, first six lines). On the other hand, the Rashkin catalyst is active immediately on formation. In fact, the calcination step is used for activation of the catalyst powder (see column 4, lines 40 - 45). Thus, a separate step of activation under hydrogen stream with or without a mixture of an inert gas like nitrogen is not required in the Rashkin process.

There is no direct teaching in Rashkin (read with or without Kawai et al) or any implication of the need for a separate step of activation, *in situ* or otherwise, for the catalyst. In fact, the Kawai et al reference specifically teaches that the catalyst can be used as such. Even where activation is done, it is prior to the use and not *in situ* (see Rashkin at column 6, lines 35 - 48). The catalyst of the present invention displays better selectivity and performance at least in part due to the step of *in situ* activation.

2. In the Rashkin catalyst, zinc is used for the specific purpose of enhancing selectivity in liquid phase hydrogenation of acetophenone and reduced production to ethyl benzene (see Rashkin at column 6, lines 40 - 44). However, in the catalyst of the invention, the enhanced selectivity for the hydrogenation of diethyl maleate to tetrahydrofuran is partly due to the entire composition of the catalyst and also due to its physical characteristics, and not due to the presence of any one ingredient.

3. Kawai et al teaches that a solvent is preferable during dehydrogenation to maintain catalyst activity, improved yield and to facilitate handling. On the other hand, hydrogenation of diethyl maleate to tetrahydrofuran using the catalyst of the invention is done in vapor phase - with no loss of activity or yield or difficulty in handling.

4. Rashkin clearly teaches that the activity of the catalyst reduces greatly depending on the presence of zinc while selectivity does increase (see Rashkin examples 1 and 2, columns 7 and 8). In other words, the enhancement of selectivity by the inclusion of zinc is at the cost of the activity of the catalyst during use. There is no teaching in Rashkin read with

Kawai et al that the situation would be any different if the substitution (suggested as obvious by the Examiner) were done.

On the other hand, in the catalyst of the invention, despite the tremendous enhancement in selectivity (the selectivity indicated in the examples of the specification are all above 20%), the loss in activity is marginal permitting easy regeneration and recycling (see specification at page 5, lines 7 - 9).

Even assuming for the sake of argument that the cited references were sufficient to set forth a *prima facie* case of alleged obviousness, the evidence discussed above would be sufficient to overcome such *prima facie* case. As discussed, the primary reference, Kawai, does not distinguish between three, four, five (or more) component catalysts containing the recited elements whereas the evidence of record shows that (only) the claimed four component catalyst has an unexpectedly high selectivity for THF. These results could not have been expected from the cited art. So, for example, the results could not be expected from Kawai et al. The Kawai et al patent does not disclose the specific proportions of the component of the catalyst. Kawai et al concerns a dehydrogenation process for dehydrogenating alicyclic diol while the present invention concerns a catalyst specific for hydrogenation process of an ester, i.e., diethyl maleate to produce an ether i.e., tetrahydofuran with 99% selectivity. The starting materials are unrelated and most importantly, the reaction types are totally opposite to each other. The results also could not be expected from Rashkin. The substitution considered to be obvious by the Examiner in the Rashkin catalyst would not be expected to work in the process of the present invention and *a fortiori* would not be expected to exhibit 99% selectivity. In fact, in the process

described in the Rashkin patent, the selectivity of the described product is only 4.3 weight percent.

In view of the above, all rejections and objections of record are believed to have been successfully traversed and the application is believed to be in allowable form. An early Notice of Allowability is earnestly solicited and is believed to be fully warranted.

An early and favorable reconsideration of the application as amended is respectfully requested.

Respectfully submitted,

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